UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

Date June 2, 1999

MEMORANDUM

SUBJECT: Tetrachlorvinphos (Chemical ID No. 083701/List A Reregistration Case No. 0321) Revised Occupational and Residential Exposure and Risk Assessment. D254823 and D256540.

FROM: Susan Hanley, Chemist
Reregistration Branch 1
Health Effects Division (7509C)

THROUGH: Whang Phang, Ph.D., Branch Senior Scientist
Reregistration Branch 1
Health Effects Division (7509C)

TO: William Hazel, Chemist
Reregistration Branch 1
Health Effects Division (7509C)
and
Demson Fuller/Mark Wilhite (PM 51)
Reregistration Branch 1
Special Review and Reregistration Division (7508W)

The public comments on the preliminary occupational and residential exposure and risk assessment of the HED RED chapter for tetrachlorvinphos were summarized in a memorandum dated 1/7/99 (S. Hanley, DP Barcode D252001) and any necessary corrections were incorporated into this revision. The Hartz Mountain Corporation (Hartz Mountain) submitted additional data along with various protocols in support of the residential uses of tetrachlorvinphos. The residential study data have not been received by the Agency as of this date and will not be included in this revision. Results from the completed study on handler exposure to active ingredient in impregnated collars will be assessed in this revision.

CONCLUSIONS

The residential exposure data generated from the impregnated collar study are within an order of magnitude of the value used according to the Residential SOPs. In the Residential SOPs 1 percent of the active ingredient in the collar is assumed available for exposure; the study resulted

in 0.3 percent of the ai being available. Although the collar studies submitted did not follow guideline specifications (low replicate numbers, limited QA/QC and high LOQ) they were of sufficient quality for use in this reassessment. Table 1 contains the study data of the amount of ai exposure to the cotton gloves worn by the applicator.

The initial calculations in the memorandum dated 1/7/99 (S. Hanley, DP Barcode D252001) did not convert grams to milligrams for the collar scenario; therefore the exposure and dose were incorrect. The corrected value for exposure and MOE have been calculated and are presented along with the study data calculations in Table 2. Considering the new data from Hartz Mountain study, risks from the collar use are below the Agency's level of concern (MOEs >100).

Tetrachlorvinphos is a suspected human carcinogen, therefore further calculations of lifetime average daily dose (LADD) are necessary. The LADD is based on an amortization of the total daily absorbed dose, over the lifetime of an individual and assumed length of pet ownership. As stated in the 1/7/99 memorandum(S. Hanley, D252001) the carcinogenic risk is calculated by multiplying the LADD by the $Q_1^* = 1.83 \times 10^{-3}$. The Q_1^* was calculated for the HED Cancer Peer Review Committee using the Weibull 83 time-to-tumor model. Table 3 has the calculations for Carcinogenic Risk for handlers of collars, using Residential SOPs and the Hartz Mountain exposure studies (MRID 44780501, MRID44780502).

According to the Residential SOPs, collar application is considered a handler application exposure and not a quantifiable postapplication exposure. Therefore, negligible postapplication risk is expected. Collar scenarios were combined with the calculated carcinogenic risk of a handler using aerosol spray application of tetrachlorvinphos products. The carcinogenic risk from collar placement did not significantly increase the risk resulting from the use of other products.

Attached to this memorandum is the corrected version of the HED Occupational and Residential Risk assessment. Additions were made to include the preliminary flea collar study data and correct calculations for the pet collar scenario.

Attachment 1
Tables Regarding the Preliminary Pet Collar Study and Associated Residential Risks

Table 1: Amount of Tetrachlorvinphos found on gloves when applying EPA Reg No.2596-62 collars

Replicate Study Number	Left Hand Exposure (mg)	Right Hand Exposure (mg)	Total (mg)
MRID 44780501			
233	2.681	4.341	7.022
302	3.418	4.240	7.658
303	3.452	4.925	8.377
316	3.298	4.055	7.353
1063	4.384	3.011	7.395
1075	3.842	5.471	9.313
Average (Range)	3.5125 (2.68-4.38)	4.3405 (4.06-5.47)	7.853 (7.02-9.31)
MRID 44780502			
221	3.162	7.581	10.743
268	2.206	6.001	8.207
297	2.242	4.854	7.096
301	4.626	9.949	14.575
329	3.021	7.456	10.477
1053	3.136	9.552	12.688
Average (Range)	3.0655 (2.21-4.63)	7.5655 (4.85-9.95)	10.631 (7.10-14.58)
Overall Average of 1475 and 1478	3.269	5.953	9.222

Table 2 : Residential Collar Handler Risk Assessment for Tetrachlorvinphos.

Exposure Scenario: Pet Collar (24g, 15% ai)	Dermal Unit Exposure (% active ingredient)	Inhalation unit Exposure	Application Rate	Daily Treated	Daily Dermal Exposure (mg/day)	Daily Inhalation Exposure (mg/day)	Absorbed Dermal Dose (mg/kg/day)	Absorbed Inhalation Dose (mg/kg/day)	Total Absorbed Daily Dose (mg/kg/day)	Sort-and Intermediate Term MOE
Residential SOPs	1	NA	3.6g ai/collar	1 dog	36	NA	0.049	NA	0.049	86
Study: MRID44780501 and MRID 44780502	0.3	NA			10.8	NA	0.015	NA	0.015	280

Table 3: Residential Collar Handler Carcinogenic Risk over a lifetime.

Use	Absorbed Daily Dose[a] (mg/kg/day)	Amortization		LADD[b] (mg/kg/day)	Carcinogenic Risk[c] (mg/kg/day)
		Treatment (Days/year)	Years of lifetime (70 yrs)		
Dog Collar Residential SOPs	0.049	2 collars	20/70	$7.7 \times 10^{/5}$	1.4×10^{-7}
			40/70	1.5×10^{-4}	2.8×10^{-7}
Dog Collar MRID 44780501, MRID 44780502	0.015		20/70	2.3×10^{-5}	4.3×10^{-8}
			40/70	4.7×10^{-5}	8.6×10^{-8}

a Absorbed Daily Dermal Dose is from Table 2.

b LADD (lifetime average daily dose) = (absorbed dermal dose)*(number of treatment days / 365days) *(number of years of pet ownership/70 year lifetime)

c Carcinogenic Risk = (LADD)*(Q_1^*), where the Q_1^*, is 1.83 x 10-3 $(mg/kg/day)^{-1}$

Attachment 2
Tetrachlorvinphos (Chemical ID No. 083701/List A Reregistration Case No. 0321)Occupational and Residential Exposure and Risk Assessment.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

5/27/99

MEMORANDUM:

SUBJECT: Tetrachlorvinphos . (Chemical ID No. 083701/List A Reregistration Case No. 0321). Occupational and Residential Exposure and Risk Assessment. DP Barcode D252001

FROM: Susan Hanley, Chemist
Reregistration Branch 1
Health Effects Division (7509C)

THROUGH: Whang Phang, Ph.D., Branch Senior Scientist
Reregistration Branch 1
Health Effects Division (7509C)

TO: Demson Fuller/Mark Wilhite (PM 51)
Reregistration Branch 1
Special Review and Reregistration Division (7508W)

A comprehensive human health risk assessment was completed for the organophosphate (OP) active ingredient tetrachlorvinphos [(Z)-2-chloro-1-(2,4,5-trichlorophenyl)vinyl dimethyl phosphate] (K. Boyle RED Chapter dated 4/1/98) which superceded a risk assessment completed in 1995. The 4/98 version of the RED carcinogenic risk assessments were conducted for occupational and residential exposures. In the 4/98 RED Chapter, risk assessments for short- and intermediate-term residential and occupational exposures were deemed unnecessary, since Agency toxicologists had not identified toxic effects attributable to a single dose in studies conducted in laboratory animals.

In May and June of 1998, meetings were conducted to assess consistency in selecting endpoints and safety factors for all organophosphate pesticides. During these meetings, the HED Hazard Identification Assessment Review Committee (HIARC) selected endpoints for short- and

intermediate-term risk assessments for tetrachlorvinphos. The FQPA Safety Factor Committee determined that the additional safety factor required under FQPA could be removed for tetrachlorvinphos (Hazard Assessments for the Organophosphates: Report of the HIARC and FQPA Safety Factor Recommendations for the Organophosphates, B. Tarplee and J. Rowland, 7/7/98 and 8/6/98, respectively).

Use Patterns supported through reregistration include oral larvicide uses for livestock, direct dermal treatment of beef and dairy cattle (including lactating cattle), horses, poultry and swine; and livestock premise treatments. Homeowner use products allow application to pets and their bedding to control fleas and ticks. Handler and postapplication exposures will be aggregated in the residential scenarios.

Summary/Conclusions

HED is most concerned with risks estimated for postapplication residential exposures. In both short- and intermediate-term non-cancer exposure scenarios and for carcinogenic risk, the Agency's level of concern is exceeded. The specific exposure scenarios include contact with treated pets that involves dermal contact (adults and toddlers) and hand-to-mouth activity (toddlers only). Only one study's preliminary data was available for this assessment; no other chemical specific data were used in assessing residential exposures. Estimates of carcinogenic risk are considered to be conservative, based on assumptions made regarding the number of applications per year, the amount/rate applied and the number of years of pet ownership. The conservative nature of the frequency of use assumption is supported by the results of the National Home and Garden Pesticide Use Survey completed by the Agency in 1992. Additionally, the application rate for the cancer assessment is the maximum labeled rate.

1 Occupational and Residential Exposure/Risk Assessment

An occupational and/or residential exposure assessment is required for an active ingredient if (1) certain toxicological criteria are triggered and (2) there is potential exposure to handlers (mixers, loaders, applicators) during use or to persons entering treated sites after application is complete. Tetrachlorvinphos toxicological endpoints were selected for short- and intermediate-term exposures, no chronic exposure scenarios are thought to exist for tetrachlorvinphos. In addition, tetrachlorvinphos is classified as a Group C possible human carcinogen and it has a Q_1*of 1.83×10^{-3}. Based on the potential for exposure, risk assessments are required for occupational and residential handlers and for residential postapplication scenarios.

a. Use Pattern/Available Products Summary for Exposure Assessments

Tetrachlorvinphos ((Z)-2-chloro-1-(2,4,5-trichlorophenyl)vinyl dimethyl phosphate) is an insecticide federally registered for use as an oral larvicide for livestock and for direct treatment of beef cattle, dairy cattle (including lactating animals), horses, poultry, swine, livestock premises, and pets.

The formulations registered for use on animals include wettable powder, treated articles (ear tags), dust, ready-to-use solution and emulsifiable concentrates. Other than treated articles, these formulations may be applied directly as a spray, as a backrubber solution, in a dust-bag, and as a dust. Tetrachlorvinphos granules or pellets also can be used for feed-through purposes or supplied in a mineral block supplement to control fecal flies (oral larvicide). The formulations registered for animal premise treatments include the wettable powder, dust, and emulsifiable concentrate, which may be applied as paint on and/or residual spray. *[Source: Office of Pesticide Programs – Reference Files System(REFS) search conducted 4/7/94]*.

No tetrachlorvinphos end-use products are currently registered for use on any plant commodity.

The following table summarizes all active Section 3 labels; their formulation, percent active ingredient and EPA registration number. The distribution of these labels is as follows: 2 technical products, 6 wettable powders, 16 dusts, 55 feed through (granules), 5 emulsifiable concentrates, 3 pressurized liquids, 6 ready to use sprays and 9 impregnated materials. There are no SLN labels active for this product according to the REFS review.

Form	Percent active ingredient	EPA Registration Number
Technical	98.7	2596-131; 4691-149
Wettable powder	50; 75	70-191; 4691-128,-129,-139; 28293-76; 34704-432; 47000-68
Dust	3; 1	70-192,-224; 299-188; 2393-393; 2596-78,-79; 4691-131,-138; 19713-340; 28293-13; 34704-266,-276,-307; 47000-66,-67; 67517-40
Feed through (Granules)	2.5; 1.5; 7.8; 97.3; 1; 0.7; 0.3; 97; 0.2; 1.2; 0.35	270-164,-165; 602-268; 1304-63,-64,-66,-68; 1352-60;1990-386,-387; 2011-5,-6,-7,-10; 4691-133,-134,-135; 4987-5; 6482-8; 6552-12,-13,-14,-17; 7138-12; 7455-23; 7627-21,-22,-26; 7698-7; 9078-6,-12; 9374–8,-9; 12714-3; 20552-2; 37774-1; 38092-3; 38110-4,-7,-8,-9; 40833-4,-5,-6,-8,-11,-12; 41200-2; 43757-1; 44666-1; 48390-1; 55392-3; 59345-1; 65901-1; 67517-26
Emulsifiable Concentrate	3; 24; 23;	2596-119; 4691-132,-136,-137; 67517-33
Pressurized Aerosol	1.1	2596-122,-123,-141
Ready to use Spray	1.1; 1; 2	2596-125,-126,-136,-140; 28293-27,-28
Impregnated Materials	14.55; 13.7	2596-49,-50,-62,-63,-83,-84,-139; 4691-150,-151;

Tetrachlorvinphos is an organophosphate insecticide that works as a contact or systemic poison and is used to control pests on animals or in and around animal quarters. The use sites are as follows:

Terrestrial Feed Crop: Cattle feedlots.
Indoor food: Agricultural/Farm Structures/Buildings and Equipment, Beef/Range/Feeder Cattle, Cattle Feedlots, Dairy Cattle (Lactating or Unspecified), Hog/Pig/Swine (Meat), Livestock, Poultry (Meat).
Indoor Residential: Cats (Adults/Kittens), Dogs/Canines (Adults/Puppies), Household/Domestic Dwellings Indoor Premises.
Indoor Nonfood: Horses (Show/Race/Special/Ponies), Mink (Fur Animal), Sheep, Specialized Animals.

The target pests are: fleas, ticks, lice, mites, spiders, wasps, cattle grubs, and flies- both larvae and adults.

Tetrachlorvinphos has a number of residential and occupational uses. For clarity, these have been separated into occupational and homeowner/residential uses.

2 Handler (mixer/loader/applicator) Exposure/Risk Assessment

Tetrachlorvinphos is applied using handheld equipment or as a feed through or via rub on application. Application rates include either specific maximum rates for cattle/swine and other farm animal premise treatments. Other labels indicate delivery through a "permit free access" (e.g., free-choice mineral blocks, feed- through or rub-on products).

The Agency has determined that there is potential exposure to mixers, loaders and applicators the during mixing/loading of liquids and wettable powders, also from applying aerosol spray, dusts, granules/pellets, using high pressure or low pressure handwands, and

treated articles. The current exposure assessment is based on the product labels that contain representative: uses, rates of active ingredient application and application scenarios. These labels are: EPA Registration Numbers: 4691-132, 4691-133, 4691-128 (previously 56493-29, 56493-34, 56493-13, which were transferred).

Based on the use patterns the following major exposure scenarios were identified for tetrachlorvinphos. These exposure scenarios are: (I) mixing/loading liquids for spray applications, (II) mixing/loading granules for feed-through, (IIIa) mixing/loading wettable powder for high pressure handwand application (data from MRID 426223-01), (IIIb) mixing/loading wettable powder for high pressure handwand application (data from PHED 1.1), (IV) applying tetrachlorvinphos using a product in an aerosol can, (V) animal dusters, (VI) applying pellets, (VIIa) applying tetrachlorvinphos using high pressure handwand (data from MRID 426223-01), (VIIb) applying tetrachlorvinphos using high pressure handwand (data from PHED 1.1), (VIIc) applying tetrachlorvinphos using high pressure handwand, double layer clothes, gloves and dust/mist respirator, (VIII) mixing, loading and applying tetrachlorvinphos using a low pressure handwand, and (IX) mixing/loading/applying tetrachlorvinphos using a backpack sprayer.

a. Data Sources

Mixer/loader/applicator (M/L/A) exposure studies were required in the Guidance for the Reregistration of Pesticide Products Containing Tetrachlorvinphos (October 1988). Data from one indoor site and one outdoor site were required.

Chemical-specific M/L/A data for Rabon® 50 WP were generated using high pressure handwands for the interior of poultry houses (MRID 426223-01). This study is not included in PHED, but has been used in this risk assessment. The data from this study have been accepted for use in this chapter (See Memo K. Boyle dated 6/18/98).

MRID 426223-01: Dermal and inhalation levels were quantified for workers applying tetrachlorvinphos product Rabon® 50 WP in a poultry house using high power handwand sprayers. The study monitored 16 replicates (e.g., four workers and four replicates) of mixing/loading and 16 replicates of application for inhalation and dermal exposures. The sprayers applied Rabon® 50 WP with handheld wand-type sprayer via a crack and crevice type application to floors, walls and ceilings of poultry houses in two different locations in Delaware. Each mixing/loading replicate consisted of mixing 20 lb ai in 225 gallons of water in a 2000 gallon tank. Each applicator sprayed 8.9 to 32 lb ai in 102 to 362 gallons of water per replicate. MRIDs 442027-01 and 442027-02 contain supporting data, such as method validation and storage stability data.

Dermal exposure was monitored using cotton whole body dosimeters (i.e., union suits) worn under polyester/cotton coveralls. Head and neck exposures were monitored with patches (cotton glove fabric in aluminum foil frames) approximately 50-60 cm^2 each. Workers wore neoprene chemical-resistant gloves. Hand exposure was monitored using hand rinse solutions. SKC Chromasorb 106 air sampling tubes were

used to monitor inhalation exposure. QA/QC procedures included field recoveries, method validation and concurrent laboratory recoveries were acceptable.

Exposure data were also used from the Pesticide Handlers Exposure Database Version 1.1(PHED V1.1), which was developed by Health Canada, the American Crop Protection Association, the California Department of Pesticide Regulation and the EPA. PHED V1.1 was initially released for public use in 1992. PHED is a comprehensive exposure database containing a large number of measured values of dermal and inhalation exposure for pesticide workers (e.g., mixers, loaders, and applicators) involved in the handling or application of pesticides in the field. The database currently contains data for over 2000 monitored exposure events. Use of surrogate or generic data is appropriate since it is generally believed that the physical parameters of the handling and application process (e.g. the type of formulations, the method of application, and the type of clothing), not the chemical properties of the pesticide, control the amount of dermal and inhalation exposure. Thus, PHED allows exposure and risk assessments to be conducted with a much larger number of observations than available from a single exposure study.

PHED also contains algorithms that allow the user to complete surrogate task-based exposure assessments beginning with one of the four main data files contained in the system (i.e., mixer/loader, applicator, flagger, and mixer/loader/applicator). Users select data from each file and construct exposure scenarios that are representative of the use of the chemical. HED, in conjunction with the PHED task force, has evaluated all of the data currently in PHED, and developed a surrogate exposure table that contains a series of standard exposure estimates for various scenarios. These standard unit exposure values are the basis for this assessment. PHED calculates "best fit" exposure values by assessing the distributions of exposures for each body part included in datasets selected for the assessment (e.g., chest or forearm) and then calculating a composite exposure value representing the entire body. PHED categorizes distributions as normal, lognormal, or in an "other" category. Generally, most data contained in PHED are lognormally distributed or fall into the PHED "other" distribution category. If the distribution is lognormal, the geometric mean for the distribution is used in the calculation of the "best fit" exposure value. If the data are an "other" distribution, the median value of the dataset is used in the calculation of the "best fit" exposure value. As a result, the surrogate unit exposure values that serve as the basis for this assessment generally range from the geometric mean to the median of the selected data set.

There are three basic risk mitigation approaches considered appropriate for controlling occupational exposures. These include administrative controls, the use of personal protective equipment or PPE, and the use of engineering controls. Occupational handler exposure assessments are completed by HED using a baseline exposure scenario and, if required, increasing levels of risk mitigation (PPE and engineering controls) to achieve an appropriate margin of exposure (MOE) or cancer risk. [Note: Administrative controls available generally involve altering application rates for handler exposure scenarios. These are typically not utilized for completing handler exposure assessments because of the negotiation requirements with registrants.] The baseline clothing/PPE ensemble for occupational exposure scenarios is generally an individual wearing long pants, a long-sleeved shirt, no chemical-resistant gloves,

and no respirator. The first level of mitigation generally applied is PPE. As reflected in the calculations included herein, PPE involves the use of an additional layer of clothing, chemical-resistant gloves and a dust/mist respirator. The next level of mitigation considered in the risk assessment process is the use of appropriate engineering controls which, by design, attempt to eliminate the possibility of human exposure. Examples of commonly used engineering controls include closed tractor cabs, closed mixing/loading/transfer systems, and water-soluble packets.

b. Occupational Exposures and Risks (non-cancer)

HED's first step in performing a handler exposure assessment is to complete a baseline exposure assessment. Tables 9, 9A and 9B present daily dermal and inhalation exposure values for baseline and additional PPE clothing scenarios. Table 9 contains the daily exposure unit values with baseline represented as the unit exposure with long-sleeved shirt, long pants no respirator and no gloves. The additional PPE unit exposures represent daily exposure while wearing long-sleeved shirt, long pants, chemical resistant gloves and a dust/mist respirator. Where noted, additional PPE of a second layer of clothing consists of long-sleeved shirt, long pants has been added. The assumptions include application rates according to listed label uses, specific application methods and a value for the amount of tetrachlorvinphos that can be used in a single working day based on the job function (e.g., acres per day).

In Table 9A, the daily dermal exposure, daily dose and risks to handlers was calculated for baseline scenarios (i.e., no additional PPE) as described below. The first step is to calculate daily dermal exposure using the following formula:

Daily Dermal Exposure (mg ai/day) = Unit Exposure (mg ai/lb ai) * Application Rate (lb ai/A) *Daily Acres Treated (A/day).

Where:

Daily Dermal Exposure = Amount deposited on the surface of the skin that is available for dermal absorption, also referred to as potential dose (mg ai/day);
Unit Exposure = Normalizes exposure value derived from May 1997 PHED Surrogate Exposure Table or December 1997 SOPs for Residential Exposure Assessment Surrogate Exposure Table for homeowner applications, for Scenarios IIIa, VII use chemical-specific handler data from MRID 426223-01 (mg ai/pound ai applied);
Application Rate = Normalized application rate based on a logical unit treatment such as acres or on a per animal basis, a maximum value is generally used (lb ai/A or lb ai/animal); and
Daily Acres Treated = Normalized application area based on a logical unit treatment such as acres or numbers of animals (A/day or animals/day).

Daily dermal dose was then calculated by normalizing the daily dermal exposure value by body weight and accounting for dermal absorption (i.e., a biologically available dose resulting from dermal exposure). For adult handlers using tetrachlorvinphos, a body weight of 70 kg was used for all exposure scenarios because the toxic effect (cholinesterase inhibition) is not sex-specific. Additionally, a dermal absorption factor of 9.57 percent (from MRID 421115-01) was used for all calculations. Daily dermal dose was calculated using the following formula:

$$\text{Daily Dermal Dose}\left(\frac{\text{mg ai}}{\text{kg/day}}\right) = \text{Daily Dermal Exposure}\left(\frac{mg\ ai}{day}\right) * \left(\frac{\text{Dermal Absorption Factor}(\%/100)}{\text{Body Weight (kg)}}\right)$$

The next step was to calculate the daily inhalation exposure for handlers. The process used is similar to that used to calculate the daily dermal dose to handlers. Daily inhalation exposure

levels were presented as (µg/lb ai) values in the PHED Surrogate Exposure Table of May 1997 (i.e., these values are based on an inhalation rate of 29 liters/minute and an 8 hour exposure interval). Once the unit exposure value is presented in this form and converted to (mg/lb ai), the calculations essentially mirror those presented above for the dermal route using a value of 100 percent absorption (i.e., a daily inhalation dose is calculated in mg/kg/day).

The handler exposure assessment does not include any dietary or drinking water inputs.

Finally, the calculations of daily dermal dose and daily inhalation dose received by handlers were then combined to assess the total risk to handlers for each exposure scenario. Short- and Intermediate-term total MOEs were calculated using the NOAEL of 4.23 mg/kg/day (Note; See the Swartz Memo dated November 2, 1998; Addendum to HED RED) and the formula below:

$$MOE = \frac{NOEL\left(\frac{mg}{kg/day}\right)}{TotalDailyDose\left(\frac{mg}{kg/day}\right)}$$

A margin of exposure (MOE) uncertainty factor of 100 is considered to be protective for both the short- and intermediate-term exposures to tetrachlorvinphos.

Table 9B represents calculated dermal and inhalation exposure and dose as in Table 9A, with risk mitigation, such as PPE, at increasing levels to achieve MOEs that are below the level of concern. Most scenarios were found to be acceptable with single layer clothes (i.e., long-sleeved shirt, long-pants), chemical resistant gloves and a dust/mist respirator. The high pressure handwand (VIIc) required double layer of clothes, chemical resistant gloves, and a dust/mist respirator. The backpack scenario (IXb) is not within Agency's level of concern for relevant risks [MOE $\geq$100 (MOE = 3.8 and 6.4 respectively)] with additional PPE including the double layer clothes, chemical resistant gloves and a dust/mist respirator (Table 9B).

Table 10 summarizes the caveats and parameters specific to the data used for each exposure scenario. These caveats include descriptions of the source of the data and an assessment of the overall quality of the data. Generally, the assessment of data quality is based on the number of observations and the available quality control data. Quality control data are assessed based on grading criteria established by the PHED task force and the reliability of any assumptions excerpted from the *SOPs for Residential Exposure Assessment (September 1997)* when it is appropriate. Additionally, it should be noted that all calculations were completed based on current HED policies pertaining to the completion of occupational and residential exposure/risk assessments (e.g., rounding, exposure factors, and acceptable data sources).

c. Occupational Handler Carcinogenic Risk Assessment

Since tetrachlorvinphos is a suspected human carcinogen it is assumed that any amount of exposure will lead to some degree of carcinogenic risk. It is also assumed that risk is directly and linearly proportional to exposure, regardless of the dosing schedule. This approach utilizes a slope factor known as the cancer potency factor, Q_1^*, calculated by the HED Cancer Peer Review Committee. The Q_1^* value was established using Weibull 83 time-to-tumor model, resulting in a Q_1^*

$=1.83 \times 10^{-3}$. Table 11 uses the Q_1^* and amortizes the Total Daily Absorbed Dose from Table 9A to calculate the carcinogenic risk.

The first step to calculate the carcinogenic risk is to amortize the Total Daily Absorbed Dose from Table 9A over the working lifetime of occupational handlers based on use patterns, this results in the Lifetime Average Daily Dose (LADD). As identified in Table 10, product labels recommend weekly use before flies appear until cold weather restricts their activity. This results in a 6 month use period or a full year use period depending on climate. Finally, a 35 year career of a 70 year lifespan covers the number of years of application. The resulting equation for LADD follows:

$$LADD\left(\frac{mg}{kg/day}\right) = Total\ Absorbed\ Daily\ Dose\left(\frac{mg}{kg/day}\right) * \frac{\text{Annual Treatment Days}}{365\ \text{Days / year}} \left(\frac{35\ \text{years working}}{70\ \text{year lifespan}}\right)$$

The Carcinogenic Risk is calculated as follows:

$$Carcinogenic\ Risk = LADD\ (mg/kg/day) * Q_1^*(mg/kg/day)^{-1.}$$

Where $Q_1^* = 1.83 \times 10^{-3}$.

LADD for occupational exposure with additional PPE (Table 12) is calculated using the same equations as Table 11 and the Total Absorbed Daily Dose from Table 9B. The LADD with additional PPE multiplied by the Q_1^* results in a carcinogenic risk range of 2.4×10^{-7} (low pressure handwand, VIII) to 1.5×10^{-4} [(backpack, single layer clothes, gloves and a dust/mist respirator, IXa) Table 12].

Table 12A considers the same PPE and Total Absorbed Daily Dose with a 3 days per year application during a 35 year career of a 70 year lifespan. This is considered a more typical use and results in a carcinogenic risk between 2.7×10^{-8} (low pressure handwand) to 8.6×10^{-6} (backpack, single layer clothes, gloves and a dust/mist respirator, IXa).

d. Residential Handler/Applicator Exposure/Risk (non-cancer)

Products containing tetrachlorvinphos are registered for use on dogs and cats for control of ticks and fleas. A *REF*s search conducted on 10/7/98 identified 102 products containing tetrachlorvinphos. End-use products with residential uses are marketed in the following formulations: impregnated collars, powders/dusts, emulsifiable concentrates, aerosol spray (pressurized liquids), ready-to-use pump sprays and wettable powders. No tetrachlorvinphos-specific data are available, estimates were made using the best available data and the professional judgements of the HED staff. The draft Standard Operating Procedures (SOPs) for Residential Exposure Assessments (September 1997) as well as the available data (aerosol spray) in PHED were used for estimating dermal exposure.

There are some data available on use of pesticides in and around the home. The National Home and Garden Pesticide Use Survey (NHGPUS) is a one-time survey of the use of pesticides in and around homes in the 48 co-terminus States and the District of Columbia. Data were collected for the 12 month period ending on the date of the interview. Interviews were conducted in August and September 1990 at 2,078 residences (households). The data from NHGPUS interviews indicated that: (1) the 95 percent confidence interval for use of a flea or tick collar is 13.79 to 19.07 percent, (2) of the households surveyed, 86.11 percent did not use pesticide treatments on cats, dogs or kennels, 1.92 percent of the households surveyed applied pesticide products to cats and dogs 1 time in the past year, (3) 1.76 percent of the households surveyed applied pesticide products to cats and dogs 2 times in the past year (4) 3.31 percent of the households surveyed applied pesticide products to cats and dogs 3 to 6 times in the past year, (5) 2.66 percent of the households surveyed applied pesticide products to cats and dogs 7 to 12 times in the past year, (6) 3.20 percent of the households surveyed applied pesticide products to cats and dogs 13 to 52 times in the past year, and (7) < 1 percent of the households surveyed applied pesticide products to cats and dogs 53 to 104 times in the past year. The percentage of households caring for a pet was not specified in this survey.

A series of assumptions and exposure factors served as the basis for completing homeowner handler risk assessments. Each assumption is detailed below on an individual basis:

- The average body weight of an adult used in all assessments is 70 kg because the NOAEL used for the short- and intermediate-term assessments (4.23 mg/kg/day) is based a dose-response assessment (MRID 421115-01). For toddler assessments, 15 kg weight was used as directed by SOPs for Residential Exposure Assessment.

- For direct animal treatments, a range in size of small or large dog sizes was used due to the label applications not specifying dose/weight unit range. When applicable, specific amount of product and ai was used (i.e., horse spray).

- Residential pet concerns were assessed based on guidance provided in the SOPs for Residential Exposure Assessment. According to SOP 9.2.1, 20 percent of the application rate is available as dislodgeable residue and 10 percent of that residue is transferred to pet owner. The SOPs also assumed no dissipation of active ingredient due to a need to maintain a level of efficacy.

- Exposure factors used by HED in this assessment include a method for calculating the application rate to pet animals based on a relationship between skin surface area and weight (EPA Wildlife Exposure Factors Handbook as discussed in SOPs for Residential Exposure Assessments); hand-to-mouth frequency of 1.56 times per hour, total skin area per hand-to-mouth event of 350 cm^2 (i.e., entire surface of both hands); quantitative transfer for each hand-to-mouth event; and infinite replenishment of residues for dermal and hand-to-mouth exposure scenarios in a residential setting.

- The SOPs for Residential Exposure Assessment also assumed the pet surface area was 6000 cm^2 considered the average surface area of a medium size dog (30 lb.).

For residential use of collars, dips, powders and spray products, exposure risk assumptions were based on different scenarios. Table 13 contains the scenarios and Table 14 contains the scenario descriptions, caveats and sources for the values. All scenarios are split into 2 application rates to represent a small animal or a large animal treatment, according to label directions and guidance from the draft SOPs for Residential Exposure Assessments (9/97). The collar scenarios were not divided due to the nature of the impregnated article treatment. These are described below:

Exposure Scenarios

- Dip scenarios are for 3 percent active ingredient concentrate solutions diluted 2 ounces to yield 1 gallon or 8 ounces to yield 4 gallons, depending on size of pet. (EPA Reg. No.: 2596 -119, 4691-139,28293-76).

- For powder or dust applications, use of one-half or one container per application (113g product per container, 3 percent active ingredient) is considered, per label directions, the animal and kennel areas can also be treated.(EPA Reg. No.:56493-44).

- Labels of impregnated collars state efficacy of 3-7 months, therefore, 2 collars/year for both cats and dogs was used in calculation, ai contained is 14.55 percent. (EPA Reg No.:2596-49,-50,-62,-63,-83,-84)

- Directions for Sprays and Aerosols for dogs and cats state to coat lightly, use of one-half of spray can is assumed per draft Residential SOPs (9/97).(EPA Reg No.:2596-87,-89)

- Pump sprays use varies with size and species, dog and cat products state to spray coat to reach skin again, one-half can assumed; the horse spray label specifies use of 2 fluid ounces.(EPA Reg. No.: 2596-122,-123,-125,-126,-136,-140,-141, 28293-27)

Baseline Dermal Unit Exposure

- Dermal exposure units from product handling/application according to the draft Residential SOPs (9/97), except aerosol spray data which comes from PHED V1.1.

Baseline Inhalation Unit Exposure

- Due to the low vapor pressure and conservative assumptions on which the dermal assessment is based (i.e., highest application rate and maximum area treated) inhalation exposure is considered minimal compared to the dermal exposure. For Aerosol sprays the PHED V1.1 data was used, an inhalation value is available for calculations.

Application Rates

- Application rates according to label directions or size of container when one-half of container is used (grams or milligram a.i./container).

Daily Treated

- Residential SOPs state one animal application per treatment.

As in Tables 9 and 9A, Table 13 contains the calculations for residential scenario daily dermal and daily inhalation exposure, daily absorbed dermal and inhalation doses and the total daily absorbed dose. The total daily absorbed dose is compared to the short- and intermediate-term

NOAEL of 4.23 mg/kg/day. Acceptable MOEs of >100 were obtained in both impregnated collars and aerosol sprays, the remainder of scenarios had MOEs between 4.5 and 64. Mitigation of exposure by additional PPE is not applicable in residential exposure scenarios. The equations used in Table 13 are as follows:

Daily Dermal Exposure (mg/day) = Baseline Dermal Exposure(% of ai applied, or mg/lb ai) * Application Rate(mg ai)* Daily Treated (animal/day)

Daily Inhalation Exposure (mg/day) Aerosol = Baseline Unit Exposure (μg/lb ai) * Application Rate (g ai) *Daily Treated (animal/day).

Daily Absorbed Dermal Dose = Daily Dermal Exposure * Dermal Absorption Rate/100percent

Daily Absorbed Inhalation Dose = Daily Inhalation Exposure * 100 percent

Total Daily Absorbed Dose = Daily Absorbed Dermal Dose + Daily Absorbed Inhalation Dose

Short-/Intermediate-term MOE = NOAEL/ Total Daily Absorbed Dose

e. Residential Applicator/Handler-Carcinogenic Risk

Table 15 is a carcinogenic risk assessment for each residential scenario based on the Absorbed Daily Dose obtained in Table 13 and the tetrachlorvinphos Q_1^* of 1.83 x10^{-3}(mg/kg/day)$^{-1}$. PPE mitigation is not considered feasible in the residential use or post application exposures. The amortization for pet product use is set out in the table, one pet per household assumed. According to the NHGPUS survey, 5 and 12 treatments per year was used. Considering the various lifespans of pets and a possible successions of pets, 20 and 40 years of pet ownership during a 70 year life span is considered a conservative estimate. All values calculated for residential carcinogenic risk for application a tetrachlorvinphos product were around 10^{-6} .

3 Postapplication Exposure/Risk Assessment

a. Occupational Post-Application Exposure/Risk (non-cancer)

Since none of the registered uses of tetrachlorvinphos are within the scope of the Worker Protection Standard for Agricultural Pesticides, restricted-entry intervals (REIs) are not required on the labels of products containing tetrachlorvinphos. Tetrachlorvinphos can be used as a feed-through. Given the mechanized systems for feed delivery in most feed-lots and the nature of manure removal, HED concludes that post-application exposure is minimal. (Note that the highest risk estimate for mixing liquid or granular tetrachlorvinphos in the feed is 3.9 x 10^{-6}).

HED is concerned about potential post-application exposure arising from re-entering indoor premises, such as poultry houses. Given the nature of activities performed in a poultry house, such as visually checking the condition of the caged birds, as well as feeding, and watering, contact with treated surfaces should be minimal. Therefore, the potential for dermal post-application exposure is assumed to be minimal. Since the vapor pressure of tetrachlorvinphos is 2.6 x 10^{-7} mm Hg at 25° C, HED concludes that post-application inhalation exposure is also minimal within treated poultry houses or other treated agricultural facilities.

Based on the use patterns for tetrachlorvinphos the potential for post-application exposure

is considered to be minimal, and post-application exposure data are not required.

b. Residential Exposure/Risk Postapplication (non-cancer)

Residential risks were assessed for both adults and toddlers based on guidance provided in the draft *SOPs For Residential Exposure Assessment* and the *Draft: Series 875-Occupational and Residential Exposure Test Guidelines, Group B-Postapplication Exposure Monitoring Test Guidelines (7/24/97 Version)*. HED considered several populations and exposure scenarios in this residential postapplication risk assessment as tetrachlorvinphos can be used in several ways that might potentially create a risk for a residential population. Home pet treatments were selected by HED as scenarios that are representative of tetrachlorvinphos risks in the residential environment. For the home use scenario, risks attributable to non-dietary ingestion and dermal exposure were also assessed for toddlers after contact with treated pets based on the guidance provided in the *SOPs For Residential Exposure Assessment* [e.g., 20 percent of the per animal application is considered transferable, of which 10 percent transferable is used to represent dermal dose (SOP 9.2.1); for hand to mouth exposure 20 percent is considered transferable, with 100 percent oral absorption for toddlers (SOP 9.2.2)]. Risks were assessed using large pets as the application rates varied based on the size of the treated animals.

The equation for Total Daily Exposure postapplication for adults becomes:

$$\text{Total daily exposure} = \frac{\text{Transferable residue x fraction transferred x dermal absorption x Application Rate}}{70kg}$$

And for Toddler:

$$\text{Total Daily Exposure} = \frac{\text{Transferable residue x fraction transferred x dermal absorption x Application Rate}}{15kg}$$

Toddler Hand-to-Mouth exposure from Residential Exposures Assessment SOPs was calculated as follows:

$$\text{Toddler hand to mouth} = \frac{\text{Transferable residue x Application Rate x (350 cm2 surface area/event) x 1.56 events/hour x 2 hr pet exposure/day}}{\text{15kg x 6000cm2 surface area/pet}}$$

Table 16 contains the residential postapplication exposure risks for tetrachlorvinphos product uses on pets. For the short- and intermediate-term assessment daily dose levels were compared directly to the short-and intermediate-term NOAEL of 4.23 mg/kg/day.

3 Risk Assessment

a. Summary of Total risks to Occupational Handlers

HED identified exposure scenarios based on available labels. As indicated, surrogate data were used to develop some of the exposure/risk assessments for occupational handlers, some chemical specific data was available for the occupational scenarios. In some cases appropriate surrogate data were not available to serve as the basis for an assessment. The scenarios for which no appropriate data were available are presented below (for both short- and intermediate-term exposures):

- application of dust to animals; and
- applying pellets for feed-through fly control.

Baseline: In cases where chemical-specific or appropriate surrogate data were available, a risk assessment was completed. The calculations of short- and intermediate-term total risks (i.e., toxicological endpoints are the same) indicate that the MOEs are more than 100 at the baseline clothing scenario for the following (see Table 9A):

- (I) Mixing/loading liquids for spray application;
- (II) Mixing/loading granules in feed;
- (IIIa) Mixing/loading wettable powder (MRID 426223-01), data includes use of chemical resistant gloves;
- (IV) Applying aerosol spray;
- (VIIa) applying with a high pressure handwand (MRID 426223-01), data includes use of chemical resistant gloves; and
- (VIII) Low pressure handwand (liquid, open pour).

PPE: In cases where additional PPE was applied the following scenarios obtained an exposure level with an MOE of more than 100. This level of additional PPE represents, long sleeved shirt, long pants, chemical resistant gloves and a dust/mist respirator (see Table 9B).

- (IIIb) Mixing/loading wettable powder.

Applying with a pressure handwand obtained an MOE of 94 at this level of additional PPE, and with the addition of a second layer of clothes the MOE became 150.

Engineering controls: Engineering controls are not applicable for most of the scenarios, and when they are applicable (e.g., wettable powder in soluble bags) the mitigation is not necessary.

Regardless of the level of risk mitigation, by the addition of PPE, one exposure scenario's **MOE value never exceeded 100.** This scenario was:

- (IXa, IXb) Backpack sprayer.

b. Occupational Risk from Postapplication Exposure

As indicated in section 2a, HED finds the use patterns of tetrachlorvinphos does not contain postapplication exposure risk in the occupational setting. Since there is no plant use for tetrachlorvinphos, and mechanized uses minimize exposure in feed lots, no REIs need to be assigned.

c. Occupational Carcinogenic Risk

At baseline values, all carcinogenic risks were between 7.8 $x10^{-8}$ to 6.5 x 10^{-5} except the backpack scenario. The exposure scenarios were amortized over the working lifetime of the applicator considering 6 month to one full year of tetrachlorvinphos use and those values were multiplied by the Q1* of 1.83 x 10^{-3}. When the range of use included 3 treatments per year, the backpack values at baseline fell to 1.7 x 10^{-5} (see Table 11 and 11A).

With the addition of PPE mitigation of exposure to the occupational scenarios, the values for the carcinogenic risk were between 2.4 x 10^{-7} to 2.9 x 10^{-6}, and backpack carcinogenic risks fell between 4.2 x 10^{-5} and 1.5 x 10^{-4}. Again, to achieve a more moderate assessment, the exposures were amortized with PPE for three treatments per year resulting in carcinogenic risks between 2.7 x 10^{-8} to 8.6 x 10^{-6} for all values (see Table 12 and 12A).

d. Summary of Residential Handler Risk: Non-cancer

No chemical-specific data were available to support pet treatments, therefore, HED identified residential exposure scenarios according to the *SOPs for Residential Exposure Assessment* and assessed each for handler/applicator exposure to the tetrachlorvinphos pet products. Two scenarios obtained an MOE above 100. They are the following (see Table 13):

- Application of aerosol spray.

- The registrant did submit preliminary data on residential handler dermal exposure to pet collars (MRID 44780501, MRID 44780502). The percentage of ai found on the handler's glove from the collar was 0.3 percent. The Residential SOPs assume 1 percent is available. The study is not complete, and this data was set out for comparison only. The total daily absorbed dose calculated from the study data is 0.015 mg/kg/day for dog collars. This results in MOEs >100. The MOEs for the same scenario according to the Residential SOPs is <100 (see Table 13).

According to the *SOPs for Residential Exposure Assessment*, mitigation by addition of PPE is not appropriate in residential scenarios. Each scenario for the application was based on the label uses for the product form. According to the *SOPs for Residential Exposure Assessment*, 10 percent of the applied ai is available for exposure for the applied products. One percent of the ai is assumed available for exposure for the impregnated materials (collars). PHED V1.1 was available for use for the aerosol spray application scenario.

The remaining scenarios that **did not exceed a MOE of 100** are:

- Dipping a dog (any size);
- Dusting a dog (any size); and
- Dog and cat collars (Residential SOPs)
- All pump spray scenarios.

d. Summary of Residential Handler: Carcinogenic Risk

Each scenario from the residential handler risk assessment was amortized to obtain the residential LADD. Carcinogenic risk was calculated by multiplying the residential LADD by the Q1* of 1.83×10^{-3} . Greater than one-half (27 of 48 scenarios) of the handler carcinogenic risks were above 10^{-6}. The dipping a large dog scenario resulted in the highest risk of 3.1×10^{-5} (see Table 15).

e. Residential Postapplication Exposure: Non-cancer.

Residential postapplication exposures were also assessed based on guidance from *SOPs for Residential Exposure Assessment* for adult and toddler exposures, including toddler hand-to-mouth exposures. HED considered the postapplication exposure from pet applications of tetrachlorvinphos products. Residential risks attributable to nondietary ingestion and dermal exposure were also assessed for toddlers after contact with treated pets based on the guidance provided in the *SOPs for Residential Exposure Assessment* (e.g., 20 percent of the per animal application is considered transferable while 10 percent of the transferable is used to represent dermal exposure, surface area of the pet is 6000 cm^2 and the surface area of both of the toddlers hands is 350 cm^2). No residential postapplication exposure had an acceptable MOE of greater than 100 (see Table 16).

Postapplication exposures to adults were amortized over the lifetime of the pet owner to obtain the carcinogenic risk (see Table 17). The postapplication exposures were dissipated over 7 days according to the label directions to apply pet products every 7 to 10 days. These exposure values were averaged to obtain exposure level over 6 day intervals after each treatment. Once the average was obtained, the value was multiplied by the Q_1* of 1.83×10^{-3} and the number of days of exposure (days of treatment x 7 days of average exposure-Table 17). This is not according to the *SOPs for Residential Exposure Assessment* which assume a level of effectiveness must be maintained therefore, the *SOPs* allow no dissipation rate. Pet ownership was also considered to be 20 or 40 years of a lifetime of 70 years. One pet treated at a time is assumed. The residential carcinogenic risk for 5 treatments per year (obtaining 35 days of exposure, day 0 through day 6) ranged from 4×10^{-7} to 1.3×10^{-5}. For 12 treatments per year (84 days of exposure, day 0 through day 6) the carcinogenic risk was 1×10^{-6} to 3×10^{-5}.

f. Aggregate Residential Risk Assessments

When the handler/applicator carcinogenic risk and postapplication carcinogenic risks were aggregated, the values were between 5.9×10^{-8} to 3.9×10^{-5} for the total risk (see Table 18). Further chemical specific studies on residential use of tetrachlorvinphos pet products may be required to refine this risk assessment.

Table 9: Baseline Exposure Values for Occupational Uses of Tetrachlorvinphos (Mixer/Loader/Applicator)

No.	Exposure Scenario (Scen. #)[a]	Unit Exposure				Rates	
		Baseline[b]		Additional PPE[c]			
		Dermal (mg/lb ai)	Inhalation (µg/lb ai)	Dermal (mg/lb ai)	Inhal. (µg/lb ai)	Maximum Application Rate	Daily Max Treated[d]
Mixer/Loader Exposure							
I	Mixing/loading liquids for spray application	2.9	1.2	0.023	0.24	0.027 lb ai/cow	400 cattle
II	Mixing/loading granules in feed	0.0084	1.7	n/a	n/a	0.14 lb ai/cow	400 cattle
IIIa	Mixing/loading wettable powder (data from MRID 42622301)	0.3 (gloves)	24	n/a	n/a	40 lb ai/poultry house	1 poultry house
IIIb	Mixing/Loading wettable powder (data from PHED)	3.7 (no gloves)	43	0.17	8.6	40 lb ai/poultry house	1 poultry house
Applicator Exposure							
IV	Applying spray with Aerosol Can	172	2.43	n/a	n/a	0.00433 lb a.i/can	1 can
V	Applying dust with Dusters	No Data	No Data	n/a	n/a	No Data	No Data
VI	Applying Pellets	No Data	No Data	n/a	n/a	No Data	No Data
VIIa	Applying with a High Pressure Handwand (data from MRID 42622301)	0.6 (gloves)	0.006	n/a	n/a	40 lb ai/poultry house	1 poultry house
VIIb	Applying with a High Pressure Handwand (data from PHED 1.1)	1.8	79	0.37	16	40 lb ai/poultry house	1 poultry house
Mixer/Loader/Applicator							
VIII	Low Pressure Handwand (liquid open/pour)	102	0.030	0.43	0.0060	1.4 lb active ingredient/A	2.5 acre[f]
IXa	Backpack[e]	483	0.330	234	0.066	1.4 lb ai/A	2.5 acre[f]
IXb	Backpack, double layer clothes, gloves	n/a	n/a	136	0.066	1.4 lb ai/A	2.5 acre[f]

a NOTE: Scenarios are from PHED for scenarios IIIb and VIIb.

b Baseline -- workers wearing single layer clothing, no gloves and no respirator. Workers wore chemical-resistant gloves for scenario numbers IIIb and VII (from MRID 42622301

c Additional PPE – workers typically wear long-sleeved shirt, long pants (double layer of clothing where noted), chemical resistant gloves, and dust/mist respirator. Specific PPE listed in Table 10 for each scenario.

d Values represent the maximum area (number of animals) which is assumed to be used in a single day to complete treatments for each exposure scenario of concern.

e Backpack is applicator only, not mixer/loader/applicator due to low confidence data and lack of hand data for liquid (open/pour) backpack. See Table 10 for data quality for backpack applicator.

f The available information indicates that approximately 2.5 acres is appropriate.

Table 9A: Baseline Occupational Handler Short and Intermediate Dermal and Inhalation Exposures to Tetrachlorvinphos

No.	Exposure Scenario	Daily Exposure (mg/day)[a]			Absorbed Daily Dose (mg/kg/day)[b]			Short/Int. Term MOE[c]
		Dermal	Inhalation	Total	Dermal	Inhalation	Total	
Mixer/Loader Exposure								
I	Mixing/loading liquids for spray application	31	0.0013	31	0.043	1.9×10^{-4}	0.043	100
II	Mixing/loading granules in feed	0.47	0.095	0.57	6.4×10^{-4}	1.4×10^{-3}	2.0 x 10-3	2100
IIIa	Mixing/loading wettable powder (data from MRID 42622301)	12	0.96	13	0.016	0.014	0.030	140
IIIb	Mixing/Loading wettable powder (data from PHED)	148	1.7	150	0.20	0.025	0.23	19
Applicator Exposure								
IV	Applying spray with Aerosol Can	0.74	0.01	0.75	1.0×10^{-3}	1.5×10^{-4}	1.2×10^{-3}	3700
V	Applying dust with Dusters	No data	No data	No data	No data	No data	No data	No data
VI	Applying Pellets	No data	No data	No data	No data	No data	No data	No data
VIIa	Applying with a High Pressure Hand Wand (data from MRID 42622301)	24	0.24	24	0.033	3.4×10^{-3}	0.036	120
VIIb	Applying with a High Pressure Hand Wand (data from PHED 1.1)	72	3.2	75	0.098	0.045	0.14	30
VIIc	Applying with a High Pressure Handwand (data from PHED 1.1, double layer clothes, dust/mist respirator)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Mixer/Loader/Applicator								
VIII	Low Pressure Handwand (liquid open/pour)	357	0.11	357	0.49	1.5×10^{-3}	0.49	876
IXa	Backpack	1690	1.2×10^{-3}	1690	2.3	1.7×10^{-5}	2.3	1.8
IXb	Backpack (data from PHED 1.1, double layer clothes, dust/mist respirator)	N/A	N/A	N/A	N/A	N/A	N/A	N/A

"No data" indicates that no appropriate data are available for incorporation into this cell. "N/A" indicates that this scenario is not appropriate in this table.

a Daily Dermal Exposure (mg/day)= Baseline Dermal Unit Exposure*Max. Label App. Rate* Daily Max Treated
Daily Inhalation Exposure (mg/day)= Baseline Inhalation Unit Exposure*Max. Label App. Rate* Daily Max Treated*1mg/1000 µg
Total Daily Exposure (mg/day) = Daily Dermal Exposure + Daily Inhalation Exposure.

b Absorbed Dermal Daily Dose (mg/kg/day) = Daily Dermal Exposure (mg/day) * dermal absorption (9.57% /100) / body weight (70kg)
Absorbed Inhalation Daily Dose (mg/kg/day) = Daily Inhalation Exposure (mg/day) / body weight (70kg)
Total Absorbed Daily Dose (mg/kg/day) = absorbed dermal daily dose + absorbed inhalation daily dose.

c Short/Intermediate Term MOE = NOAEL/Total Daily Absorbed Dose. NOAEL = 4.23 mg/kg/day.

Table 9B: Occupational Handler Short-term and Intermediate-term Risks from Tetrachlorvinphos with Additional PPE.

No.	Exposure Scenario[a]	Daily Exposure with Additional PPE[b] (mg/day)			Absorbed Dose with Additional PPE[c] (mg/kg/day)			Additional PPE Short/Int. Term MOE[d]
		Dermal	Inhalation	Total	Dermal	Inhalation	Total	
Mixer/Loader Exposure								
I	Mixing/loading liquids for spray application	N/A	N/A	N/A	N/A	N/A	N/A	N/A
II	Mixing/loading granules in feed	N/A	N/A	N/A	N/A	N/A	N/A	N/A
IIIa	Mixing/loading wettable powder (data from MRID 42622301)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
IIIb	Mixing/Loading wettable powder (data from PHED)	6.8	0.35	7.1	9.3×10^{-3}	5.0×10^{-3}	0.014	300
Applicator Exposure								
IV	Applying spray with Aerosol Can	N/A	N/A	N/A	N/A	N/A	N/A	N/A
V	Applying dust with Dusters	No data	No data	No data	No data	No data	No data	No data
VI	Applying Pellets	No data	No data	No data	No data	No data	No data	No data
VIIa	Applying with a High Pressure Handwand (data from MRID 42622301)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
VIIb	Applying with a High Pressure Handwand (data from PHED 1.1)	26	0.64	27	0.036	0.0091	0.045	94
VIIc	Applying with a High Pressure Handwand (data from PHED 1.1, double layer clothes, dust/mist respirator)	14	0.64	15	0.019	0.0091	0.028	150
Mixer/Loader/Applicator								
VIII	Low Pressure Handwand (liquid open/pour)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
IXa	Backpack	819	0.23	819	1.1	3.3×10^{-3}	1.1	3.8
IXb	Backpack, double layer clothes, gloves, dust/mist respirator	476	0.23	476	0.66	3.3×10^{-3}	0.66	6.4

"No data" indicates that no appropriate data are available for incorporation into this cell. "N/A" indicates that no further risk assessment is required for this scenario (i.e., an appropriate risk level has been attained prior to application of the current mitigation level).

a Exposure data is from PHED 1.1, for single layer clothes (i.e.,long sleeved shirt, long pants) and additional PPE specifically chemical resistant gloves, and a dust/mist respirator. Scenarios VIIc and IXb which consider, double layer of clothes, chemical resistant gloves and a dust/mist respirator. See Table 10 for description.

b Additional PPE Daily Dermal Exposure (mg/day)=Additional PPE Dermal Unit Exposure*Max. Label App. Rate* Daily Max Treated
Additional PPE Daily Inhalation Exposure (mg/day)=Additional PPE Inhalation Unit Exposure*Max. Label App. Rate* Daily Max Treated
PPE Total Daily Exposure (mg/day) = Additional PPE Daily Dermal Exposure + Additional PPE Daily Inhalation Exposure.

c Absorbed Dermal Daily Dose (mg/kg/day) = Daily Dermal Exposure (mg/day) * dermal absorption (9.57% /100) / body weight (70kg)
Absorbed Inhalation Daily Dose (mg/kg/day) = Daily Inhalation Exposure (mg/day) / body weight (70kg)
Total Absorbed Daily Dose (mg/kg/day) = absorbed dermal daily dose + absorbed inhalation daily dose.

d Short/Intermediate Term MOE = NOAEL/Total Daily Absorbed Dose. NOAEL = 4.23 mg/kg/day.

Table 10: Exposure Scenario Descriptions for Tetrachlorvinphos

Exposure Scenario (Scen. #)	Data Source	Clothing Scenario	Equipment	Assumptions[b]	Comments[c]
Mixer/Loader Exposure					
Mixing/loading liquids for spray application (I)	PHED V1.1	Baseline: Long Pants, Long-Sleeved Shirt, No Gloves PPE: Long Pants, Long-Sleeved Shirt, Gloves, dust/mist respirator	Open Mixing/Loading	Treat cattle every 10 days for 6 months (i.e., 18 treatments) OR Treat cattle every 10 days for 12 months (i.e., 36 treatments)	**Baseline:** Hands, dermal , and inhalation acceptable grades; Dermal = 71 - 121 replicates; Hands = 53 replicates; Inhalation = 53 replicates; High confidence in dermal, hand, and inhalation data **PPE:** Hands, dermal , and inhalation acceptable grades; Dermal = 71 - 121 replicates; Hands = 59 replicates; Inhalation = 53 replicates; High confidence in dermal, hand, and inhalation data A 80% PF was applied to the inhalation exposure to account for the use of a dust/mist respirator.
Mixing/loading Granules in feed (II)	PHED V1.1	Baseline: Long Pants, Long-Sleeved Shirt, No Gloves PPE: Long Pants, Long-Sleeved Shirt, Gloves, dust/mist respirator	Open Mixing/Loading	Feed to cattle every 10 days for 6 months (i.e., 18 treatments) OR Feed to cattle every 10 days for 12 months (i.e., 36 treatments)	**Baseline:** Hands = All grades; Hands = 10 replicates; Dermal = ABC grades; Dermal = 33 to 78 replicates; Low confidence in dermal and hands due to poor grade quality of the hand replicates and low replicate numbers. Inhalation = acceptable grades; Inhalations = 58 replicates; High confidence in inhalation data **PPE:** Dermal = ABC; dermal = 33 - 78 replicates; Hands = acceptable grades; Hands = 45 replicates; medium confidence in hands and dermal; inhalation = 58 replicates; inhalation = acceptable grades; High confidence in inhalation data. A 80% PF was applied to the inhalation exposure to account for the use of a dust/mist respirator.
Mixing/loading wettable powders (IIIa)	MRID 426223-01	Single Layer Coveralls, Gloves[a]	Open Mixing/Loading	4 lb ai/100 gal; 1 gal/100 birds; 100,000 birds/facility; treat once every 14 days for 6 months (13 treatments) OR Treat once every 14 days for 12 months (26 treatments)	Acceptable grades (pending verification of storage stability); Dermal and inhalation = 16 replicates; High confidence in data (based on preliminary findings)

Table 10: Exposure Scenario Descriptions for Tetrachlorvinphos

Exposure Scenario (Scen. #)	Data Source	Clothing Scenario	Equipment	Assumptions[b]	Comments[c]
Exposure Scenario (Scen. #)	Data Source	Clothing Scenario	Equipment	Assumptions[b]	Comments[c]
Mixing/loading wettable powders (IIIb)	PHED V1.1	Baseline: Long Pants, Long-Sleeved Shirt, No Gloves PPE: Long Pants, Long-Sleeved Shirt, Gloves, dust/mist respirator	Open Mixing/Loading	4 lb ai/100 gal; 1 gal/100 birds; 100,000 birds/facility; treat once every 14 days for 6 months (13 treatments) OR Treat once every 14 days for 12 months (26 treatments)	**Baseline:** Dermal and Hands = ABC; dermal = 22 - 45 replicates; hands = 7 replicates; low confidence in dermal and hands due to the low number of hand replicates; Inhalation = ABC; Inhalation = 44 replicates; Medium confidence in inhalation data **PPE:** Dermal, hands, and inhalation = ABC, dermal = 22 - 45 replicates; hands = 24 replicates; inhalation = 44 replicates; medium confidence in dermal, hands, and inhalation data A 80% PF was applied to the inhalation exposure to account for the use of a dust/mist respirator.
Applicator Exposure					
Applying spray with aerosol can (IV)	PHED V1.1	Baseline: Long Pants, Long-Sleeved Shirt, No Gloves PPE: Long Pants, Long-Sleeved Shirt, Gloves, dust/mist respirator	Aerosol Can	1 can - 1 animal treated once per week for 6 months (26 treatments) OR 1 can - 1 animal treated once per week for 12 months (52 treatments)	**Baseline:** Dermal = 30 replicates; dermal = ABC; hand = 15 replicates; hand = A. Inhalation = 30 replicates; Inhalation = ABC; Medium confidence in inhalation, dermal and hand data. **PPE:** Dermal = 30 replicates; dermal = ABC; hand = 15 replicates; hand = A. Inhalation = 30 replicates; Inhalation = ABC; Medium confidence in inhalation, dermal and hand data. A 80% PF was applied to the inhalation exposure to account for the use of a dust/mist respirator.
Animal dusters (V)	No Data	No Data	No Data	No Data	No Data
Applying pellets(VI)	No Data	No Data	No Data	No Data	No Data
Applying with High Pressure Handwand (VIIa,)	MRID 426223-01	a: Single Layer Coveralls, Gloves [a]; 	Wandtype Sprayers, Coarse Spray, Single Nozzle, 100 ft. long hose	4 lb ai/100 gal; 1 gal/100 birds; 100,000 birds/facility; treat once every 14 days for 6 months (13 treatments) OR Treat once every 14 days for 12 months (26 treatments)	MRID 426223-01: Acceptable grades, Dermal and inhalation = 16 replicates; High confidence in data (based on preliminary findings)

Table 10: Exposure Scenario Descriptions for Tetrachlorvinphos

Exposure Scenario (Scen. #)	Data Source	Clothing Scenario	Equipment	Assumptions[b]	Comments[c]
Applying with High Pressure Handwand (VIIb, VIIc)	PHED V 1.1	b: single layer clothes, gloves, dust/mist respirator; c: double layer clothes, gloves, dust/mist respirator	Wandtype Sprayers, Coarse Spray, Single Nozzle, 100 ft. long hose	4 lb ai/100 gal;1 gal/100 birds; 100,000 birds/facility; treat once every 14 days for 6 months (13 treatments) OR Treat once every 14 days for 12 months (26 treatments)	PHED V1.1: **Baseline:** Dermal = 9 replicates; all grades; hand = 2 replicates; all grade. Inhalation = 11 replicates, all grades. Low confidence in inhalation, dermal and hand data, due to inadequate replicate numbers and poor grade quality. Additionally, the gloved hand values are based primarily on non-detects. For additional PPE a 80% PF was applied to the inhalation value to account for the use of the dust/mist respirator, and in VIIc a 50%PF was applied to the upper and lower arm, chest, back, thigh and lower leg dermal exposure to account for the use of the double layer of clothes.
Mixer/Loader/Applicator					
Low Pressure Handwand (VIII)	PHED V1.1	Baseline: Long Pants, Long-Sleeved Shirt, No Gloves PPE: Long Pants, Long-Sleeved Shirt, Gloves, dust/mist respirator	2 to 3 gallon low pressure single wand	1 acre treated once per week for 6 months (26 treatments) OR 1 acre treated once per week for 12 months (52 treatments)	**Baseline:** Inhalation = 80 replicates; Inhalation = ABC; dermal = 9 - 80 replicates; dermal = ABC; hands = 70 replicates; hands = all grades; Low confidence in hands and dermal data due to inadequate replicate number and low hand grades used (lots of E data). Medium confidence in inhalation data. **PPE:** Inhalation = 80 replicates; Inhalation = ABC; dermal = 13 replicates; dermal = C; hands = 10 replicates; hands = ABC; Low confidence in hands and dermal data due to inadequate replicate number. Medium confidence in inhalation data. A 80% PF was applied to the inhalation exposure to account for the use of a dust/mist respirator.

Table 10: Exposure Scenario Descriptions for Tetrachlorvinphos

Exposure Scenario (Scen. #)	Data Source	Clothing Scenario	Equipment	Assumptions[b]	Comments[c]
Backpack (IX)	PHED V1.1	Baseline: Long Pants, Long-Sleeved Shirt, No Gloves PPE: Long Pants, Long-Sleeved Shirt, Gloves, dust/mist respirator	2 gallon backpack	1 acre treated once per week for 6 months (26 treatments) OR 1 acre treated once per week for 12 months (52 treatments)	**No Clothing:** Dermal and hands = 69, AB grade, acceptable; dermal = 69 replicates, hand = 60 replicates. High confidence in hands and dermal data **Baseline:** Head and Neck, and Hands =AB grade; 69 replicates(hand and neck only); high confidence in hands and neck, low confidence on dermal data. A 50% protection factor (PF) was applied on dermal Upper and Lower Arm, Chest, Back, Thigh, and Lower Leg-minimal clothing exposures to simulate baseline clothing (Long sleeve shirt, long pants, no gloves: i.e. 394mg/lb ai *0.5= 195 mg/lb ai handled was then added to the hand and face and neck exposure = dermal exposure considering the one layer of clothing) Inhalation = acceptable grades; Inhalation = 40 replicates High confidence in inhalation data. **PPE:** Dermal and Hands = Acceptable grades; dermal = 69 replicates; hands = 60 replicates; high confidence in hands and dermal data. A 50% protection factor (PF) was applied on dermal Upper and Lower Arm, Chest, Back, Thigh, and Lower Leg, baseline clothing exposures to simulate PPE clothing (Long sleeve shirt, long pants, gloves). An additional 50% PF was applied on the Baseline Clothes value to account for Double Layer Clothes and a PF of 90% applied to the Hand Dermal exposure for the chemical resistant glove in the last scenario. A 80% PF was applied to the inhalation exposure to account for the use of a dust/mist respirator. Inhalation = acceptable grades; Inhalation = 40 replicates High confidence in inhalation data.

a Clothing scenario represents actual monitored exposure data in MRID 426223-01.

b Standard Assumptions based on an 8-hour work day as estimated by HED. The label specifies that treatment with larvicidal feeds should begin early in the spring before flies begin to appear and continue feeding throughout the summer and into fall until cold weather restricts fly activity. Depending on the area of the US, this could be as short as a few months or could encompass most of the year. The six month and one year applications are used in calculating the Lifetime Average Daily Dose in Tables 11 and 12.

c These grades are based on Quality Assurance/Quality Control data provided as part of the exposure studies. A replicate refers to data acquired during one complete work cycle. All handler exposure assessments in this document are based on the "Best Available" data as defined by HED SOP for meeting Subdivision U Guidelines (i.e., completing exposure assessments.) Best available grades are assigned as follows: matrices with grades A and B data (which is defined as acceptable grade data) and a minimum of 15 replicates; if not available, then grades A, B, and C data and a minimum of 15 replicates; if not available, then all data (all grades) regardless of the quality and number of replicates. High quality data with a protection factor take precedence over low quality data with no protection factor.
Data confidence as reported in the Table refers to both the quality and the quantity (number of replicates) of data for each PHED run. Each study in PHED has been graded from A to E. A high confidence run is grades A and B data and 15 or more replicates per body part. Any combination of A and B grade data are listed as acceptable grades data in the tables. A medium confidence run is grades A, B, and C data and 15 or more replicates per body part. Any combination of A, B, and C grade data are listed as ABC grade data in the tables. A low confidence run is all grades (any run that includes D or E grade data) or has less than 15 replicates per body part.

Table 11: Baseline Carcinogenic Risk Estimates for Occupational Uses of Tetrachlorvinphos

Exposure Scenario (Scenario #)	Total Daily Dose[a] (mg/kg/day)	Amortization[b]	Mixer/Loader/Applicator	
			LADD[c] (mg/kg/day)	Carcinogenic Risk[d]
Mixer/Loader Exposure				
Liquids (I)	0.043	$\left(\frac{18\,days}{365\,days/yr}\right)\left(\frac{35\,yrs}{70\,yrs}\right)$	1.1×10^{-3}	1.9×10^{-6}
		$\left(\frac{36\,days}{365\,days/yr}\right)\left(\frac{35\,yrs}{70\,yrs}\right)$	2.1×10^{-3}	3.9×10^{-6}
Granules (II)	0.002	$\left(\frac{18\,days}{365\,days/yr}\right)\left(\frac{35\,yrs}{70\,yrs}\right)$	4.9×10^{-5}	9.0×10^{-8}
		$\left(\frac{36days}{365days/yr}\right)\left(\frac{35\,yrs}{70\,yrs}\right)$	9.9×10^{-5}	2.0×10^{-7}
Wettable Powder (IIIa) MRID 42622301 (gloves)	0.030	$\left(\frac{13days}{365days/yr}\right)\left(\frac{35\,yrs}{70\,yrs}\right)$	5.2×10^{-4}	9.0×10^{-7}
		$\left(\frac{26\,days}{365\,days/yr}\right)\left(\frac{35\,yrs}{70\,yrs}\right)$	1.1×10^{-3}	2.0×10^{-6}
Wettable Powder (IIIb) PHED (no gloves)	0.23	$\left(\frac{13days}{365days/yr}\right)\left(\frac{35yrs}{70yrs}\right)$	3.9×10^{-3}	7.2×10^{-6}
		$\left(\frac{26\,days}{365\,days/yr}\right)\left(\frac{35\,yrs}{70\,yrs}\right)$	8.2×10^{-3}	1.5×10^{-5}
Applicator Exposure				
Aerosol Can (IV)*	0.0012	$\left(\frac{26\,days}{365\,days/yr}\right)\left(\frac{35\,yrs}{70\,yrs}\right)$	4.3×10^{-5}	7.8×10^{-8}
		$\left(\frac{52\,days}{365\,days/yr}\right)\left(\frac{35\,yrs}{70\,yrs}\right)$	8.6×10^{-5}	2.0×10^{-7}
Dusters (V)*	No Data	No Data	No Data	No Data
Pellets (VI)	No Data	No Data	No Data	No Data
Power Sprayers (VII)	0.036	$\left(\frac{13days}{365days/yr}\right)\left(\frac{35\,yrs}{70\,yrs}\right)$	6.4×10^{-4}	1.2×10^{-6}
		$\left(\frac{26\,days}{365\,days/yr}\right)\left(\frac{35\,yrs}{70\,yrs}\right)$	1.3×10^{-3}	2.3×10^{-6}
Mixer/Loader/Applicator				
Low Pressure Handwand (VIII)	0.50	$\left(\frac{26\,days}{365\,days/yr}\right)\left(\frac{35\,yrs}{70\,yrs}\right)$	0.018	3.3×10^{-5}
		$\left(\frac{52\,days}{365\,days/yr}\right)\left(\frac{35\,yrs}{70\,yrs}\right)$	0.036	6.5×10^{-5}
Backpack (IX)	2.3	$\left(\frac{26\,days}{365\,days/yr}\right)\left(\frac{35\,yrs}{70\,yrs}\right)$	0.083	1.5×10^{-4}
		$\left(\frac{52\,days}{365\,days/yr}\right)\left(\frac{35\,yrs}{70\,yrs}\right)$	0.16	3.0×10^{-4}

a Absorbed Total Daily Dose was estimated in Table 9A

b Amortization represents maximum label use for one half or full year treatments as set out in Table 10.

c LADD (mg/kg/day) = [Daily Dermal Dose + Daily Inhalation Dose(mg/kg/day)] * (Work Days Per Yr/365 Days Per Year) * (35 Yrs/70 Yrs).

d Risk = LADD (mg/kg/day) * (Q_1 *); where $Q_1^* = 1.83 \times 10^{-3}$ mg/kg/day^{-1}.

Table 11A: LADD and Carcinogenic Risk Amortized for 3 uses per year over working career.

Exposure Scenario (Scenario #)	Total Daily Dose[a] (mg/kg/day)	Amortization[b]	Mixer/Loader/Applicator	
			LADD[c] (mg/kg/day)	Carcinogenic Risk[d]
Mixer/Loader Exposure				
Liquids (I)	0.043	$\left(\frac{3 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	1.8×10^{-4}	3.2×10^{-7}
Granules (II)	0.002	$\left(\frac{3 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	8.2×10^{-6}	1.5×10^{-8}
Wettable Powder (IIIa) MRID 42622301 (gloves)	0.030	$\left(\frac{3 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	1.2×10^{-4}	2.2×10^{-7}
Wettable Powder (IIIb) PHED (no gloves)	0.23	$\left(\frac{3 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	9.0×10^{-4}	1.7×10^{-6}
Applicator Exposure				
Aerosol Can (IV)*	0.0012	$\left(\frac{3 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	4.9×10^{-6}	9.0×10^{-9}
Dusters (V)*	No Data	No Data	No Data	No Data
Pellets (VI)	No Data	No Data	No Data	No Data
Power Sprayers (VII)	0.036	$\left(\frac{3 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	1.5×10^{-4}	2.7×10^{-7}
Mixer/Loader/Applicator				
Low Pressure Handwand (VIII)	0.50	$\left(\frac{3 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	2.1×10^{-3}	3.8×10^{-6}
Backpack (IX)	2.3	$\left(\frac{3 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	9.5×10^{-3}	1.7×10^{-5}

a Absorbed Total Daily Dose was estimated in Table 9A

b Amortization represents 3 treatments per year, during a 35 year career within a 70 year lifespan.

c LADD (mg/kg/day) = [Daily Dermal Dose + Daily Inhalation Dose(mg/kg/day)] * (Work Days Per Yr/365 Days Per Year) * (35 Yrs/70 Yrs).

d Risk = LADD (mg/kg/day) * (Q_1 *); where $Q_1^* = 1.83 \times 10^{-3}$ mg/kg/day^{-1}.

Table 12: PPE (Personal Protective Equipment) Carcinogenic Risk Estimates for Occupational Uses of Tetrachlorvinphos

No.	Exposure Scenario (Scenario #)	Total Daily Dose[a] (mg/kg/day)	Amortization	LADD[b] (mg/kg/day)	Carcinogenic Risk[c]
Mixer/Loader					
I	Mixing/loading Liquids for spray application	N/A	N/A	N/A	N/A
II	Mixing/loading Granules in feed	N/A	N/A	N/A	N/A
IIIa	Mixing/loading Wettable Powder (MRID 426223-01)	N/A	N/A	N/A	N/A
IIIb	Mixing/loading Wettable Powder (IIIb) PHED	0.014	$\left(\frac{13 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	2.4×10^{-4}	4.6×10^{-7}
			$\left(\frac{26 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	5.0×10^{-4}	9.1×10^{-7}
Applicator Exposure					
IV	Applying Spray with Aerosol Can	N/A	$\left(\frac{26 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	N/A	N/A
			$\left(\frac{52 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$		
V	Applying dust with Duster	No Data	No Data	No Data	No Data
VI	Applying Pellets	No Data	No Data	No Data	No Data
VIIa	Applying with a High Pressure Handwand (MRID 426223-01)	N/A	N/A	N/A	N/A
VIIb	Applying with a High Pressure Handwand	0.044	$\left(\frac{13 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	7.8×10^{-4}	1.4×10^{-6}
			$\left(\frac{26 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	1.6×10^{-3}	2.9×10^{-6}
VIIc	Applying with a High Pressure Handwand	0.029	$\left(\frac{13 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	5.2×10^{-4}	9.5×10^{-7}
			$\left(\frac{26 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	1.0×10^{-3}	1.9×10^{-6}
Mixer/Loader/Applicator					
VIII	Low Pressure Handwand (liquid open/pour)(VIII)	0.0036	$\left(\frac{26 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	1.3×10^{-4}	2.4×10^{-7}
			$\left(\frac{52 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	2.6×10^{-4}	4.7×10^{-7}
IXa	Backpack (IX), single layer, gloves	1.14	$\left(\frac{26 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	4.1×10^{-2}	7.4×10^{-5}
			$\left(\frac{52 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	8.1×10^{-2}	1.5×10^{-4}
IXb	Backpack (IX), double layer, gloves	0.65	$\left(\frac{26 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	2.3×10^{-2}	4.2×10^{-5}
			$\left(\frac{52 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	4.6×10^{-2}	8.4×10^{-5}

a Total Daily Absorbed Dose from Table 9B (mg/kg/day) = Absorbed Daily Dermal Dose + Absorbed Daily Inhalation Dose

b LADD (mg/kg/day) = [Total Daily Dose(mg/kg/day)] * (Application Work Days/365 Days Per Year) * (35 Yrs/70 Yrs)

c Risk = LADD (mg/kg/day) * (Q_1 *); where $Q_1^* = 1.83 \times 10^{-3}$ mg/kg/day^{-1}.

Table 12A: LADD and Carcinogenic Risk with PPE mitigation amortized for 3 use days per year over career.

No.	Exposure Scenario (Scenario #)	Total Daily Dose[a] (mg/kg/day)	Amortization	LADD[b] (mg/kg/day)	Carcinogenic Risk[c]
Mixer/Loader					
I	Mixing/loading Liquids for spray application	N/A	N/A	N/A	N/A
II	Mixing/loading Granules in feed	N/A	N/A	N/A	N/A
IIIa	Mixing/loading Wettable Powder (MRID 426223-01)	N/A	N/A	N/A	N/A
IIIb	Mixing/loading Wettable Powder	0.014	$\left(\frac{3 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	1.4×10^{-4}	2.6×10^{-7}
Applicator Exposure					
IV	Applying Spray with Aerosol Can	N/A	$\left(\frac{3 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	N/A	N/A
V	Applying dust with Duster	No Data	No Data	No Data	No Data
VI	Applying Pellets	No Data	No Data	No Data	No Data
VIIa	Applying with a High Pressure Handwand (MRID 426223-01)	N/A	N/A	N/A	N/A
VIIb	Applying with a High Pressure Handwand	0.044	$\left(\frac{3 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	1.8×10^{-4}	3.3×10^{-7}
VIIc	Applying with a High Pressure Handwand	0.029	$\left(\frac{3 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	1.2×10^{-4}	2.2×10^{-7}
Mixer/Loader/Applicator					
VIII	Low Pressure Handwand (liquid open/pour)(VIII)	2.4 x 10-3	$\left(\frac{3 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	1.5×10^{-5}	2.7×10^{-8}
IXa	Backpack (IX), single layer, gloves	1.1	$\left(\frac{3 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	4.7×10^{-3}	8.6×10^{-6}
IXb	Backpack (IX), double layer, gloves	0.65	$\left(\frac{3 days}{365 days/yr}\right)\left(\frac{35 yrs}{70 yrs}\right)$	2.8×10^{-3}	5.0×10^{-6}

a Total Daily Absorbed Dose from Table 9B (mg/kg/day) = Absorbed Daily Dermal Dose + Absorbed Daily Inhalation Dose

b LADD (mg/kg/day) = [Total Daily Dose(mg/kg/day)] * (Application Work Days/365 Days Per Year) * (35 Yrs/70 Yrs)

c Risk = LADD (mg/kg/day) * (Q_1 *); where Q_1^* = 1.83×10^{-3} mg/kg/day^{-1}.

Table 13: Residential Handler Risk Assessment for Tetrachlorvinphos.

Exposure Scenario (Scen.#)		Baseline Dermal Unit Exposure (%, or mg/lb active ingredient)[a]	Baseline Inhalation Unit Exposure (µg/lb active ingredient)[b]	Application Rates	Daily Treated	Daily Dermal Exposure (mg/day)[c]	Daily Inhalation Exposure (mg/day)[d]	Absorbed Dermal Dose (mg/kg/day)[e]	Absorbed Inhalation Dose (mg/kg/day)[f]	Total Absorbed Daily Dose (mg/kg/day)[g]	Short-/ Int.- Term MOE[h]
Mixer/Loader/Applicator Exposure											
Dipping a Dog		10%	No Data	1700 mg a.i.	1 dog	170	No Data	0.23	No Data	0.23	18
				6800 mg a.i.		680		0.93		0.93	4.5
Dusting a Dog		10%	No Data	1.7g a.i. (½ can)	1 dog	170	No Data	0.23	No Data	0.23	18
				3.4g a.i. (1 can)		340		0.46		0.46	9.2
Dog Collar Application Res. SOPs		1%	No Data	3.6 g a.i/ collar	1 collar	36	No Data	0.049	No Data	0.049	86
Dog Collar Application MRID 44780501, MRID 44780502		0.3%	No Data			11	No Data	0.015	No Data	0.015	280
Cat Collar Res. Application Sops		1%	No Data	2.2 g a.i/ collar		22	No Data	0.044	No Data	0.044	96
Cat Collar MRID 44780501, MRID 44780502		0.3%	No Data			6.6	No Data	0.009	No Data	0.009	470
Aerosol Spray		220	2400	1.1g a.i.	1 animal	0.53	0.0058	7.2×10^{-4}	8.3×10^{-5}	8×10^{-4}	5300
				2.2g a.i.		1.1	0.012	0.0015	1.7×10^{-4}	0.0017	2500
Pump Spray	Cat ¼ bottle	10%	No Data	510mg a.i.	1 animal	51	No Data	0.07	No Data	0.07	60
	Cat ½ bottle			1020 mg a.i.		102		0.14		0.14	30
	Dog ¼ bottle			920 mg a.i.		92		0.13		0.13	33
	Dog ½ bottle			1800 mg a.i.		180		0.25		0.25	17
	Horse			480 mg a.i		48		0.066		0.066	64

a Residential handler dermal unit exposure represents short pants, short-sleeved shirt, no gloves, and open mixing/loading.

b Residential handler inhalation unit exposure represents no respirator.

c Daily Dermal Exposure (mg/day) = Baseline Dermal Unit Exposure * Application Rate * Daily Treated *[Conversion (1000mg/g) if necessary]

d Daily Inhalation Exposure (mg/day) = Baseline Unit Exposure (µg/lb ai) * (1 mg/1000 µg) Conversion * Application Rate (g o mg ai) * Daily Treated (#).

e Daily Absorbed Dose (mg/kg/day) = $\frac{\text{Daily Dermal Exposure (mg/day) * Daily Absorption Rate for Tetrachlorvinphos (0.0957)}}{\text{Body Weight (70 kg).}}$

f Daily Inhalation Dose (mg/kg/day) = Daily Inhalation Exposure (mg/day)/ Body Weight (70 kg).

g Baseline Daily Total Dose (mg/kg/day)= Baseline Daily Absorbed Dose (mg/kg/day) + Baseline Daily Inhalation Dose (mg/kg/day).

h Total MOE= short-term and intermediate $\frac{\text{NOAEL (4.23 mg/kg/day)}}{\text{Total Daily Dose (mg/kg/day).}}$

Table 14: Residential Handler Scenario Descriptions for the Use of Tetrachlorvinphos.

Exposure Scenario (Number)	Data Source	Standard Assumptions (8-hr work day)	Comments[a]
Mixer/Loader/Applicator Descriptors			
Dipping a Dog (2)	SOPs for Residential Exposure Assessments (7/97)	1 gallon of dip and 1 small dog is dipped 4 gallons of dip and 1 large dog is dipped	The SOPs For Residential Exposure Assessment served as the basis for this assessment (i.e., the assumptions that were used to predict exposures from pet use products in which a percentage of the application rate is the predictor of potential dermal dose). The scenario is based on the use of a residential clothing scenario (i.e., short pants, short-sleeved shirt, no gloves, no respirator). The refinement of the SOPs for Residential Exposure Assessment is such that further delineation based on clothing scenario is not appropriate (i.e., to alter value based on use of short vs. long pants and long-sleeved vs. short-sleeved shirts). EPA Reg. No. 2596-119.
Dusting an Animal with a Powder(1)	SOPs for Residential Exposure Assessments (7/97)	minimum dog weight (5 lb) and maximum dog weight (120 lb), 1 dog is dusted	The SOPs For Residential Exposure Assessment served as the basis for this assessment (i.e., the assumptions that were used to predict exposures from pet use products in which a percentage of the application rate is the predictor of potential dermal dose). The scenario is based on the use of a residential clothing scenario (i.e., short pants, short-sleeved shirt, no gloves, no respirator). The refinement of the SOPs for Residential Exposure Assessment is such that further delineation based on clothing scenario is not appropriate (i.e., to alter value based on use of short vs. long pants and long-sleeved vs. short-sleeved shirts). EPA Reg No. 2596-78,-79; 4691-138.
Dog and Cat Collar (3) Application	SOPs for Residential Exposure Assessments (7/97)	2 collar	The SOPs For Residential Exposure Assessment served as the basis for this assessment (i.e., the assumptions that were used to predict exposures from pet use products in which a percentage of the application rate is the predictor of potential dermal dose). The scenario is based on the use of a residential clothing scenario (i.e., short pants, short-sleeved shirt, no gloves, no respirator). The refinement of the SOPs for Residential Exposure Assessment is such that further delineation based on clothing scenario is not appropriate (i.e., to alter value based on use of short vs. long pants and long-sleeved vs. short-sleeved shirts). EPA Reg No.2596-62,-63,-139.
	MRID 44780501, MRID 44780502		The studies mentioned are preliminary and have not been reviewed by the Agency. Preliminary data from the studies was submitted to the Agency and used in this risk assessment for comparison purposes only.
Aerosol Spray	PHED V1.1	One half contents of can or one whole can depending upon size of pet.	The PHED V1.1 baseline for dermal exposure with no clothes is 390 mg/lb ai applied, and with single layer clothes (long sleeve, long pants, no gloves) is 170 mg/lb ai. Considering Residential Clothing scenario of short sleeves and short pant, a value of dermal exposure was chosen as the difference between these two clothing scenarios, 220 mg/lb ai. Both PHED scenarios had Dermal replicates=30, ABC grade and Hand replicates = 15, Grade A, Medium confidence. Inhalation also taken from PHED, represents no respirator, had 30 replicates, ABC grade, medium confidence. EPA Reg. No. 2596-122.
Pump Spray	SOPs for Residential Exposure Assessments, specifically 9.1.1	One quarter to one half ready to use spray can used on one pet, depending on size of pet	The SOPs For Residential Exposure Assessment served as the basis for this assessment (i.e., the assumptions that were used to predict exposures from pet use products in which a percentage of the application rate is the predictor of potential dermal dose). The scenario is based on the use of a residential clothing scenario (i.e., short pants, short-sleeved shirt, no gloves, no respirator). The refinement of the SOPs for Residential Exposure Assessment is such that further delineation based on clothing scenario is not appropriate (i.e., to alter value based on use of short vs. long pants and long-sleeved vs. short-sleeved shirts). EPA Reg. No. 2596-126,-125 and 28293-27 (horse).

a All *Standard Assumptions* are based on an 8-hour work day as estimated by HED. BEAD data were not available.

b All handler exposure assessments in this document are based on the "Best Available" data as defined by the PHED SOP for meeting Subdivision U Guidelines (i.e., completing exposure assessments). Best available grades are assigned to data as follows: matrices with A and B grade data (i.e., Acceptable Grade Data) and a minimum of 15 replicates; if not available, then grades A, B and C data and a minimum of 15 replicates; if not available, then all data regardless of the quality (i.e., All Grade Data) and number of replicates. High quality data with a protection factor take precedence over low quality data with no protection factor. Generic data confidence categories are assigned as follows:
High = grades A and B and 15 or more replicates per body part
Medium= grades A, B, and C and 15 or more replicates per body part
Low= grades A, B, C, D and E or any combination of grades with less than 15 replicates.

c PHED grading criteria do not reflect overall quality of the reliability of the assessment. Sources of the exposure factors should also be considered in the risk management decision

Table 15: Residential Handler Scenarios-Carcinogenic Risk for Residential Uses of Tetrachlorvinphos

Use	Absorbed Daily Dose (mg/kg/day)[a]	Amortization		LADD[b] (mg/kg/day) Amortization	Carcinogenic Risk[c]
		treatment days/year	years of lifetime		
Dip	make 1 gallon 0.23	$\frac{5 days}{365 days/yr}$	20/70	9×10^{-4}	1.6×10^{-6}
			40/70	1.8×10^{-3}	3.3×10^{-6}
		$\frac{12 days}{365 days/yr}$	20/70	2.2×10^{-3}	4×10^{-6}
			40/70	4.3×10^{-3}	7.9×10^{-6}
	make 4 gallons 0.93	$\frac{5 days}{365 days/yr}$	20/70	3.6×10^{-3}	6.6×10^{-6}
			40/70	7.3×10^{-3}	1.3×10^{-5}
		$\frac{12 days}{365 days/yr}$	20/70	8.7×10^{-3}	1.6×10^{-5}
			40/70	1.7×10^{-2}	3.2×10^{-5}
Spray Can	Entire Can dermal =1.5 x 10-3 inhalation =1.7 e -4 Total =1.7 x 10-3	$\frac{5 days}{365 days/yr}$	20/70	6.7×10^{-6}	1.2×10^{-8}
			40/70	1.3×10^{-5}	2.4×10^{-8}
		$\frac{12 days}{365 days/yr}$	20/70	1.6×10^{-5}	2.9×10^{-8}
			40/70	3.2×10^{-5}	5.8×10^{-8}
	Half the Can dermal = 7.4 e -4 inhalation =8.5 e -5 Total =8.3 e -4	$\frac{5 days}{365 days/yr}$	20/70	3.2×10^{-6}	6.0×10^{-9}
			40/70	6.5×10^{-6}	1.2×10^{-8}
		$\frac{12 days}{365 days/yr}$	20/70	7.8×10^{-6}	1.4×10^{-8}
			40/70	1.6×10^{-5}	2.9×10^{-8}
Powder/Dust	Half the Container 0.23	$\frac{5 days}{365 days/yr}$	20/70	9.0×10^{-4}	1.6×10^{-6}
			40/70	1.8×10^{-3}	3.3×10^{-6}
		$\frac{12 days}{365 days/yr}$	20/70	2.2×10^{-3}	4.0×10^{-6}
			40/70	4.3×10^{-3}	7.9×10^{-6}

Table 15: Residential Handler Scenarios-Carcinogenic Risk for Residential Uses of Tetrachlorvinphos					
Use	Absorbed Daily Dose (mg/kg/day)[a]	Amortization		LADD[b] (mg/kg/day) Amortization	Carcinogenic Risk[c]
		treatment days/year	years of lifetime		
	Entire Container 0.46	$\frac{5 days}{365 days / yr}$	20/70	1.8×10^{-3}	3.3×10^{-6}
			40/70	3.6×10^{-3}	6.6×10^{-6}
		$\frac{12 days}{365 days / yr}$	20/70	4.3×10^{-3}	8.0×10^{-6}
			40/70	8.6×10^{-3}	1.6×10^{-5}

Table 15: Residential Handler Scenarios-Carcinogenic Risk for Residential Uses of Tetrachlorvinphos					
Use	Absorbed Daily Dose (mg/kg/day)[a]	Amortization		LADD[b] (mg/kg/day) Amortization	Carcinogenic Risk[c]
		treatment days/year	years of lifetime		
Pet Collars	Cat Residential SOPs 0.044	2 collars	20/70	6.9×10^{-8}	1.3×10^{-10}
			40/70	1.4×10^{-7}	2.5×10^{-10}
	Cat MRID 447805-01 0.009		20/70	1.4×10^{-5}	2.6×10^{-8}
			40/70	2.8×10^{-5}	5.2×10^{-8}
	Dog Residential SOPs 0.049	2 collars	20/70	7.7×10^{-5}	1.4×10^{-7}
			40/70	1.5×10^{-4}	2.8×10^{-7}
	Dog MRID 447805-01 0.015		20/70	2.3×10^{-6}	4.3×10^{-8}
			40/70	4.7×10^{-6}	8.6×10^{-8}
Pump sprays	Cat One Half Bottle (4 fl.oz.) 0.14	$\frac{5 days}{365 days / yr}$	20/70	5.4×10^{-4}	1.0×10^{-6}
			40/70	1.1×10^{-3}	2.0×10^{-6}
		$\frac{12 days}{365 days / yr}$	20/70	1.3×10^{-3}	2.4×10^{-6}
			40/70	2.6×10^{-3}	4.8×10^{-6}
	Cat One Quarter Bottle (2 fl.oz.) .069	$\frac{5 days}{365 days / yr}$	20/70	2.7×10^{-4}	5.0×10^{-7}
			40/70	5.5×10^{-4}	1.0×10^{-6}
		$\frac{12 days}{365 days / yr}$	20/70	6.6×10^{-4}	1.2×10^{-6}
			40/70	1.3×10^{-3}	2.4×10^{-6}
	Dog One Half Bottle (7.25 fl.oz.) 0.25	$\frac{5 days}{365 days / yr}$	20/70	9.8×10^{-4}	1.8×10^{-6}
			40/70	2.0×10^{-3}	3.6×10^{-6}
		$\frac{12 days}{365 days / yr}$	20/70	2.4×10^{-3}	4.3×10^{-6}
			40/70	4.7×10^{-3}	8.6×10^{-6}
	Dog One Quarter Bottle (3.62 fl.oz.) 0.13	$\frac{5 days}{365 days / yr}$	20/70	5.1×10^{-4}	9.3×10^{-7}
			40/70	1.0×10^{-3}	1.9×10^{-6}
		$\frac{12 days}{365 days / yr}$	20/70	1.2×10^{-3}	2.2×10^{-6}
			40/70	2.4×10^{-3}	4.5×10^{-6}
	Horse 2 fl. oz. 0.066	$\frac{26 days}{365 days / yr}$	20/70	1.3×10^{-3}	2.5×10^{-6}
			40/70	2.7×10^{-3}	4.9×10^{-6}
		$\frac{52 days}{365 days / yr}$	20/70	2.7×10^{-3}	4.9×10^{-6}
			40/70	5.4×10^{-3}	9.8×10^{-6}

a Absorbed Daily Dermal Dose is from Table 13.

b LADD (lifetime average daily dose) = (absorbed dermal dose)*(number of treatment days / 365days) *(number of years of pet ownership/70 year lifetime)

c Carcinogenic Risk = (LADD)*(Q_1^*), where the Q_1^*, is 1.83 x 10-3 $(mg/kg/day)^{-1}$

Table 16: Residential Postapplication Adult and Toddler			
Scenario[a]	Application Rate mg a.i. applied[b]	Total daily exposure mg/kg/day[c]	MOE[d]
Adult			
Dip	6800	0.19	23
Dust	3400	0.093	46
Aerosol	2200	0.061	70
Pump	1800	0.049	86
Toddler			
Dip	6800	0.87	4.9
Dust	3400	0.43	9.8
Aerosol	2200	0.28	15
Pump	1800	0.23	18
Toddler Hand to Mouth[e]			
Dip	6800	17	0.25
Dust	3400	8.3	0.51
Aerosol	2200	5.3	0.79
Pump	1800	4.4	0.97

a Scenarios are for large pet (large dog).

b Application rate based on label for large pet uses. As presented in Table 13.

c Total Daily Exposure = $\frac{0.2 * 0.1 * 9.57\% / 100 * \text{Application Rate}}{70\text{kg}}$

d Short term and Intermediate Term NOAEL = 4.23 mg/kg/day. MOE = $\frac{\text{NOAEL}}{\text{Total Daily Dose}}$

e Hand to Mouth Scenario Total Daily Exposure $= \frac{0.2 * \text{Application rate} * 350\ cm^2/\text{ toddler hands} * 1.56\text{events/hour} * 2\text{hr/day}}{6000\ cm^2/\text{pet} * 15\text{kg}}$

Table 17: Adult Post-Application Exposures-Carcinogenic Assessment of Residential Uses of tetrachlorvinphos (5 Treatments per year)

Days After Treatment (DAT)1	Absorbed Dermal Dose by Scenario[a] (mg/kg/day)										
	Dip (1 gallon)	Dip (4 gallons)	Aerosol Spray (half can)	Aerosol Spray (entire can)	Dust (Half container)	Dust (container)	Pump Spray cat one-quarter container	Pump Spray cat one-half container	Pump Spray dog one-quarter container	Pump Spray dog one-half container	Pump Spray Horse 2 fl oz.
Day 0	0.046	0.19	0.03	0.06	0.046	0.093	0.014	0.028	0.025	0.051	0.013
Day 1	0.039	0.16	0.026	0.051	0.039	0.080	0.012	0.024	0.021	0.044	0.011
Day 2	0.034	0.14	0.022	0.044	0.034	0.068	0.010	0.021	0.018	0.037	0.001
Day 3	0.029	0.12	0.019	0.038	0.029	0.059	0.0088	0.018	0.016	0.032	0.0081
Day 4	0.025	0.1	0.016	0.032	0.025	0.050	0.0076	0.015	0.013	0.028	0.0070
Day 5	0.021	0.088	0.014	0.028	0.021	0.043	0.0065	0.013	0.012	0.024	0.0060
Day 6	0.018	0.075	0.012	0.024	0.018	0.037	0.0056	0.011	0.0099	0.020	0.0052
TWA[2]	0.03	0.13	0.02	0.04	0.030	0.061	00092	0.018	0.017	0.034	0.0089
Amortization Values for Estimating Risk [3]											
(35/365)(20/70)	1.5×10^{-6}	6.3×10^{-6}	1.0×10^{-6}	2.0×10^{-6}	1.5×10^{-6}	3.1×10^{-6}	5×10^{-7}	9×10^{-7}	8×10^{-7}	1.7×10^{-6}	4×10^{-7}
(35/365)(40/70)	3×10^{-6}	1.3×10^{-5}	2.0×10^{-6}	4.0×10^{-6}	3×10^{-6}	6.2×10^{-6}	9×10^{-7}	1.9×10^{-6}	1.7×10^{-6}	3.4×10^{-6}	9×10^{-7}
(84/365)(20/70)	3.7×10^{-6}	1.5×10^{-5}	2.4×10^{-6}	4.8×10^{-6}	3.7×10^{-6}	7.4×10^{-6}	1.1×10^{-6}	2.2×10^{-6}	2×10^{-6}	4.1×10^{-6}	1×10^{-6}
(84/365)(40/70)	7.3×10^{-6}	3×10^{-5}	4.8×10^{-6}	9.5×10^{-6}	7.3×10^{-6}	1.5×10^{-5}	2.2×10^{-6}	4.4×10^{-6}	4×10^{-6}	8.1×10^{-6}	2.1×10^{-6}

Note: Dog and Cat collar scenarios were not estimated.

1 The absorbed dose is estimated in a manner similar to that used in the Applicator Table. For post-application exposure it is assumed that 0.2 or 20% of the application rate is retained on the pet (dog, cat, or horse)as dislodgeable residue, and 0.1 or 10% of the residue is transferred to the pet-owner for all scenarios except collars. The dermal absorption factor is 0.0957.

a The absorbed dermal dose (Day 0) = [application rate (in mg)] (0.2) (0.1) (0.0957) / (70 kg)
The assumptions for application rate were taken from Table 13:

For Day(1) to (6), the dermal absorbed dose is decreased each day by 1/7, based on label instructions to repeat every few days, as necessary, or weekly. (i.e., Day 1 = Day 0 * 6/7...)

2 Time Weighted Average is the sum of the daily doses divided by the number of days.

3 Risk = (TWA)(Q_1^* which is 0.00183)(amortization). The amortization is 35/365 which considers 7 days of post-application exposure for each of the 5 treatments, or 84/365 which considers 7 days of post-application exposure for each of the 12 treatments. The 20/70 and 40/70 as used in the application scenario are also used for post-application scenarios; these represent years exposed over a 70 year lifetime.

Table 18: Handler and Post-Application Residential Adult Handler Combined Carcinogenic Risk.			
Scenario	Handler Risk[a] Absorbed Dose*(12/365)(40/70)	Post-Application Risk[b] TWA*(84/365)(40/70)	Total Risk
Dip (4 gallons)	3.2×10^{-5}	3×10^{-5}	6.2×10^{-5}
Aerosol can (entire can)	5.8×10^{-8}	9.5×10^{-6}	9.6×10^{-6}
Powder (entire container)	1.6×10^{-5}	1.5×10^{-5}	3.1×10^{-5}
Pump spray (dog) (one-half bottle)	8.6×10^{-6}	8.1×10^{-6}	1.7×10^{-5}
Combined Application and Postapplication Carcinogenic Risk Assuming 5 Applications per Year of Dip and Powder or Dip and Pump Spray			
Scenario	Handler Risk[a] Absorbed Dose*(5/365)(40/70)	Post-Application Risk[b] TWA*(35/365)(40/70)	Total Risk
Dip (4 gallons) and Powder (entire container)	1.3×10^{-5} 6.6×10^{-6}	1.3×10^{-5} 6.2×10^{-6}	2.6×10^{-5} 1.3×10^{-5} Total Risk - sum of handler and post-application risks for both products 3.9×10^{-5}
Dip (4 gallons) and Spray pump (dog, one-half bottle)	1.3×10^{-5} 3.6×10^{-6}	1.3×10^{-5} 3.4×10^{-6}	2.6×10^{-5} 7.0×10^{-6} Total Risk - sum of handler and post-application risks for both products 3.3×10^{-5}
Spray pump (dog) (one-half bottle) and Powder/Dust (entire container)	3.6×10^{-6} 6.6×10^{-6}	3.4×10^{-6} 6.2×10^{-6}	7×10^{-6} 1.3×10^{-5} Total Risk - sum of handler and post-application risks for both products 2.0×10^{-5}

Table 18: Handler and Post-Application Residential Adult Handler Combined Carcinogenic Risk.			
Scenario	Handler Risk[a] Absorbed Dose*(12/365)(40/70)	Post-Application Risk[b] TWA*(84/365)(40/70)	Total Risk
Aerosol (Entire can) and Collar (dog)**(2/365)(40/70)**	2.4×10^{-8} 2.8×10^{-7}	4×10^{-6} -----	4×10^{-6} 2.8×10^{-7} Total Risk - sum of handler and post-application risks for both products 4.3×10^{-6}

a Values are from Table 15

b Values are from Table 17: Handler (12/365) ≡Post-application(84/365); handler (5/365)≡ postapplication(35/365).